

January–February 1997
Volume 102, Number 1

ISSN 1044-677X



Journal of Research of the

National Institute of Standards and Technology



United States Department of Commerce
Technology Administration
National Institute of Standards and Technology

The National Institute of Standards and Technology was established in 1988 by Congress to “assist industry in the development of technology . . . needed to improve product quality, to modernize manufacturing processes, to ensure product reliability . . . and to facilitate rapid commercialization . . . of products based on new scientific discoveries.”

NIST, originally founded as the National Bureau of Standards in 1901, works to strengthen U.S. industry’s competitiveness; advance science and engineering; and improve public health, safety, and the environment. One of the agency’s basic functions is to develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for comparing standards used in science, engineering, manufacturing, commerce, industry, and education with the standards adopted or recognized by the Federal Government.

As an agency of the U.S. Commerce Department’s Technology Administration, NIST conducts basic and applied research in the physical sciences and engineering, and develops measurement techniques, test methods, standards, and related services. The Institute does generic and precompetitive work on new and advanced technologies. NIST’s research facilities are located at Gaithersburg, MD 20899, and at Boulder, CO 80303. For more information contact the Public Inquiries Desk, 301-975-3058.

Journal of Research of the **National Institute of Standards and Technology**

Volume 102

Number 1

January–February 1997

Board of Editors

Barry N. Taylor
Chief Editor

Nancy M. Trahey, Technology Services

Richard J. Van Brunt, Electronics and Electrical Engineering Laboratory

Theodore V. Vorburger, Manufacturing Engineering Laboratory

John R. Moody, Chemical Science and Technology Laboratory

Ronald Collé, Physics Laboratory

Kenneth L. Jewett, Materials Science and Engineering Laboratory

Nicos S. Martys, Building and Fire Research Laboratory

Alan H. Goldfine, Information Technology Laboratory

Daniel W. Lozier, Information Technology Laboratory

Matt Young, Boulder Laboratories

Chris E. Kuyatt, Washington Editorial Review Board

Donald R. Harris
Managing Editor

Julian M. Ives
Technical Production Editor



U.S. Department of Commerce—**William M. Daley**, Secretary
Technology Administration—**Mary L. Good**, Under Secretary for Technology
National Institute of Standards and Technology—**Arati Prabhakar**, Director

The Journal of Research of the National Institute of Standards and Technology features advances in measurement methodology and analyses consistent with the NIST responsibility as the nation's measurement science laboratory. It includes reports on instrumentation for making accurate and precise measurements in fields of physical science and engineering, as well as the mathematical models of phenomena which enable the predictive determination of information in regions where measurements may be absent. Papers on critical data, calibration techniques, quality assurance programs, and well-characterized reference materials reflect NIST programs in these areas. Special issues of the Journal are devoted to invited papers in a particular field of measurement science. Occasional survey articles and conference reports appear on topics related to the Institute's technical and scientific programs.

ISSN 1044-677X**Coden: JRITF****Library of Congress Catalog Card No.: 89-656121**

United States Government Printing Office, Washington: 1997

*C*ontents

Articles

Energy-Filtered High-Resolution Electron Microscopy for Quantitative Solid State Structure Determination	Z. L. Wang, D. van Heerden, D. Josell, and A. J. Shapiro	1
Optimum Design of a Ceramic Tensile Creep Specimen Using a Finite Element Method	Z. Wang, C. K. Chiang, and T.-J. Chuang	15
Interlaboratory Comparison on High-Temperature Superconductor Critical-Current Measurements	J. A. Wiejaczka and L. F. Goodrich	29
DNA Molecules as Standard Reference Materials I: Development of DNA Identification Sequences and Human Mitochondrial DNA Reference Sequences	Keith McKenney, Joel Hoskins, Jingxiang Tian, and Prasad Reddy	53
Water Calorimetry: The Heat Defect	Norman V. Klassen and Carl K. Ross	63
Extension of the NIST AC-DC Difference Calibration Service for Current to 100 kHz	Joseph R. Kinard, Thomas E. Lipe, and Clifton B. Childers	75
Results of the NIST National Ball Plate Round Robin	G. W. Caskey, S. D. Phillips, and B. R. Borchardt	85

Conference Report

The Sixth International Meeting on Chemical Sensors	Howard H. Weetall	95
---	--------------------------	----

News Briefs

GENERAL DEVELOPMENTS	107
NIST to Play Leadership Role in ILAC Directory of U.S. Standards Organizations Updated Directory of Private-Sector Product Certification Programs Updated	
GIQLP Information Now On-Line for Procurement Officials and Government Suppliers NIST TBT Agreement Activities Report Published Energy-Related Inventions Program Makes Recommendations First Fabrication of High-Temperature Superconducting Josephson Junctions on Sapphire Bicrystal Substrates	108

NIST Leading International Comparison of Capacitance at CCE Request NIST-Organized Conference on the Future of Wireless Communications Briefs Participants With 50 Presentations	109
M ³ Measures Gratings for NASA'S AXAF Project Heat-Treated Steels With Rockwell-C-Hardnesses Characterization and Hybridization Reactions of Surface-Immobilized DNA	110
¹⁴ C Measurements to Inventory Atmospheric Volatile Organic Compounds That Contribute to Ozone Formation Acoustic Vibrations of a Bose-Einstein Condensate Monitoring Ultraviolet Irradiance From the Sun	111
NIST Develops High-Contrast Broadband Infrared Polarizer Infrared Transfer Standard Detectors Developed Workshop Held on Bone Palliation Radiopharmaceuticals NIST-Industry Collaboration Leads to Improved Rheological Measurement Capability	112
High-Resolution Thermal Imaging System Demonstrated on Metal Atomization Plume New Neutron Reflectometer Installed at the Cold Neutron Research Facility NIST Studies Carbon Monoxide in Residential Buildings NIST Software Improves the Accuracy of Brain Probes	113
New Publication Features Experimental Models for Software Diagnosis ITL Officially Launched at NIST Consortium Reports on Installation Effects Digest Available on Optical Fiber Measurements	114
New Annealing Technique for Optical Fiber Current Sensors Electron-Collision Database Developed for Gases Used by the Semiconductor Industry	115
New Determination of SI Ohm Yields Improved Value of Fine-Structure Constant NIST Standard Retarder Included in the Optical Society of America's Time Capsule Manufacturer's STEP Translation Center Receives CALS Implementor Award	116
Smart Transducer Interface Demo at Sensors Conference Laser-Driven Thermal Reactor Developed for Characterizing Wastes and Fuels	117
Fundamental Constants Bibliographic Database Online SI on the Internet NIST Collaborates on Instrumentation for the SOHO Satellite Electronic Structure Calculation Database Released	118
Three Tunable X-Ray Spectrometers Delivered to NASA Field Emitter Arrays for Flat-Panel Displays Lattice Changes in SI Epilayers and SI Substrates New Report Describes Improved Accuracy in Optical Radiation	119
New Photometric Calibration Capabilities Optical Standards Aid Semiconductor Manufacturers CIRMS Holds Fifth Annual Meeting at NIST	120

Optical Frequency Division by a Factor of Three Calcium Optical Molasses Crystalline Non-Neutral Plasmas	121
Detection of Methane in Air Higher Frequency Observations Using Laser Magnetic Resonance Historic Bose-Einstein Experiment Preserved by Smithsonian Institution NIST Coordinates International Project on Characterization of Ceramic Powders	122
Constitutive Equations for Steels at High Temperatures Metallurgical Aspects of the Sinking of the RMS Titanic NIST Collaborates on Composites Process Monitoring	123
NIST Hosts DARPA IC&V Evaluation Team CRADA Project to Develop a Minimum Interoperability Specification of PKI Components Completed New Publication Focuses on Technology Required for a Computer to Read Handprinted Paragraphs NIST Hosts Prototype Conferencing Products Interoperability Events	124
Optical Fingerprint Recognition in Financial and Internet Security Applications Process to Develop Advanced Encryption Standard Begins	125
International Fiber Measurements Comparison Done Updated “One-Stop” Industry Guide to NIST Available Micromechanical Tester Available Without a License New System Takes Temperatures on a Roll	126
Researchers Collide Viruses, Cells With Laser Tweezers Chicago Center Helps Firm Increase Sales, Jobs New Measurement Gives Sharper Look to Flat Panels NACLA Proposal Accepted at Recent Meeting	127
Optoelectronics Work Highlighted in New Book Plan to Coordinate U.S. Standards Now Online	128
STANDARD REFERENCE MATERIALS Revised Standard to Help Curb Drunk Drivers	128
STANDARD REFERENCE DATA NIST Completes New Version of High-Temperature Superconductors Property Database	128
<i>Calendar</i>	131
